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Comparison of Airborne Asbestos Levels Determined by Transmission Electron Microscopy (TEM) Using Direct and Indirect Transfer Techniques

STROUP

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FINAL REPORT

COMPARISON OF AIRBORNE ASBESTOS LEVELS DETERMINED BY TRANSMISSION ELECTRON MICROSCOPY (TEM) USING DIRECT AND INDIRECT TRANSFER TECHNIQUES

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This document has been reviewed and approved for publication by the Office of Toxic Substances, Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency. The use of trade names or commercial products does not constitute Agency endorsement or recommendation for use.

AUTHORS AND CONTRIBUTORS

This report was prepared by Jean Chesson of Chesson Consulting, Inc. under subcontract to Battelle. Jeff Hatfield of Battelle prepared an earlier draft of the Study 1 (EPA 1988) results. The R.J. Lee Group, Inc., Monroeville, PA performed the laboratory analysis of samples from Study 1 as part of the study reported in EPA (1988).

The EPA work assignment manager was Brad Schultz. Substantial contributions were also made by Cindy Stroup, Betsy Dutrow, and Joe Breen of the Exposure Evaluation Division in the EPA Office of Toxic Substances.

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VI. DISCUSSION

An analytic method should be sufficiently accurate for its intended purpose. Accuracy has two components: bias and precision. Bias refers to a systematic deviation of the measured value from the true value of the quantity being measured. In this case the objective is to characterize exposure in a biologically meaningful way, that is, in terms of the number and type of structures that are inhaled. Precision refers to the uncertainty associated with repeated measurements of the same quantity. The direct transfer method is often characterized as being less biased than the indirect transfer method, whereas the indirect transfer method is considered more precise by some researchers. Neither of these claims is supported by extensive data. Bias and precision are discussed in turn below, together with suggestions for further research that could assist in selecting the appropriate analytical method for a given situation.

A. Bias

Bias must be considered within the context of the application. If measurements are to be used in a comparative manner (e.g., comparing airborne asbestos levels inside and outside a building), a bias that applies equally to both sets of measurements may not affect the comparison. If, however, the objective is to measure exposure in order to assess risk, a bias may have a significant impact on the interpretation of the data. Although the details are controversial, it is thought that the dimension of asbestos structures is important in determining the incidence of disease. Special attention should be devoted to minimizing bias with respect to asbestos structures that contribute most to disease incidence. (Note that the contribution is determined not only by relative potency of asbestos structures of different sizes, but also by their relative abundances.) An ideal measurement method would mimic the effect of respiration, etc. on complex structures (BCM) so that those that readily disintegrate would be represented by their individual components, while those that are firmly linked would be counted and sized as single structures.

The studies considered in this paper all support the generally accepted belief that airborne asbestos concentrations estimated by an indirect transfer method are larger than those estimated by a direct transfer method. Breakdown of larger structures during the ashing, sonication, and resuspension steps is assumed to be the main explanation for the difference. Fiber size information from Studies 1 and 5, however, does not provide strong support for this hypothesis. Although more small fibers are counted using an indirect transfer method, there is not a corresponding